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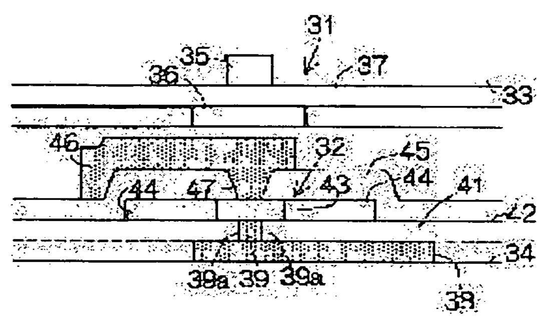
(54) CPP STRUCTURE ELECTROMAGNETIC TRANSDUCER AND ITS MANUFACTURING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a CPP structure electromagnetic transducer, capable of further narrowing a path of a current to be supplied to an electromagnetic transducing film without depending upon the contraction of the transducing film.
SOLUTION: The CPP structure electromagnetic transducer 32 comprises upper side and lower side drawer conducive layers 46 and 38 for supplying sense currents to the electromagnetic transducing film 43. A conductive terminal piece 39 rises on the surface of the lower side drawer conductive layer 39. The path of the current is specified on the contact surface of the piece 39 with the film 43. The path of the current can be decided based on the spread of the upper surface of the top of the piece 39 contacted with the film 43. In such a CPP structure electromagnetic transducer 32, the path of the current to the film 43 can be narrowed without depending upon the contraction of the film 43.



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CLAIMS

[Claim(s)]
[Claim 1] a bottom drawer conductive layer, the electric conduction terminal strip which starts from the front face of a bottom drawer conductive layer, the insulator layer which spreads on the front face of a bottom drawer conductive layer, touching the wall surface of an electric conduction terminal strip, and the electromagnetism which lies in the summit side of an electric conduction terminal strip at least -- the conversion film and electromagnetism -- the CPP structure characterized by having a top drawer conductive layer in contact with the summit side of the conversion film -- electromagnetism -- a sensing element.
[Claim 2] CPP structure according to claim 1 -- electromagnetism -- a sensing element -- setting -- said electromagnetism -- the CPP structure characterized by specifying the conversion film by the 2nd piece with said bigger electric conduction terminal strip than the 1st piece -- electromagnetism -- a sensing element.
[Claim 3] CPP structure according to claim 2 -- electromagnetism -- a sensing element -- setting -- said electromagnetism -- the CPP structure characterized by forming the conversion film on 1 flattening side specified on the summit side of said electric conduction terminal strip, and the front face of an insulator layer -- electromagnetism -- a sensing element.
[Claim 4] CPP structure according to claim 3 -- electromagnetism -- a sensing element -- setting -- said electromagnetism -- the CPP structure characterized by conversion film being either the spin bulb film and tunnel junction film -- electromagnetism -- a sensing element.
[Claim 5] CPP structure according to claim 4 -- electromagnetism -- a sensing element -- setting -- said bottom drawer conductive layer -- said electromagnetism -- the CPP structure characterized by functioning as a magnetic shielding layer of the conversion film -- electromagnetism -- a sensing element.
[Claim 6] CPP structure according to claim 5 -- electromagnetism -- a sensing element -- setting -- the 3rd piece smaller than said 2nd piece to said top drawer conductive layer -- said electromagnetism -- the CPP structure characterized by forming the terminal phyma in contact with the conversion film in one -- electromagnetism -- a sensing element.
[Claim 7] the process which forms an electric-conduction wafer in the front face of a drawer conductive layer, the process at which an insulator layer is formed in the front face of a drawer conductive layer, flattening processing performs for an electric-conduction wafer to a wrap process and an insulator layer by the insulator layer, and the summit side of an electric-conduction wafer exposes in respect of flattening on an insulator layer, and the electromagnetism which lie in the summit side of an electric-conduction wafer at least -- the CPP structure characterized by to have the process which forms the conversion film on a flattening side -- electromagnetism -- the manufacture approach of a sensing element.
[Claim 8] CPP structure according to claim 7 -- electromagnetism -- in advance of formation of said electric conduction wafer in the manufacture approach of a sensing element with the process which forms said drawer conductive layer according to a regular configuration pattern on the front face of a basic layer the CPP structure characterized by having further the process at which a basic insulator layer is formed in the front face of a basic layer, and it pulls out by the basic insulator layer, and flattening processing is performed to a wrap process and a basic insulator layer, a conductive layer is pulled out in respect of flattening on a basic insulator layer, and the front face of a conductive layer is exposed -- electromagnetism -- the manufacture approach of a sensing element.
[Claim 9] CPP structure according to claim 8 -- electromagnetism -- the manufacture approach of a sensing element -- setting -- said electromagnetism -- the process which forms a wrap covering insulator layer for the conversion film, and a covering insulator layer -- penetrating -- said electromagnetism -- the CPP structure characterized by to have the process which forms the contact hole which arrives at the front face of the conversion film, and the process which fills up the formed contact hole with an electrical conducting material -- electromagnetism -- the manufacture approach of a sensing element.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] electromagnetism [this invention], such as for example, spin bulb film and tunnel junction film, — the conversion film and this electromagnetism — the electromagnetism from perpendicularly it intersects with the conversion film — CPP (Current Perpendicular-to-the-Plane) structure equipped with the top and bottom drawer conductive layer which put the conversion film — electromagnetism — it is related with a sensing element.
[0002]
[Description of the Prior Art] By magneto-resistive effect film, such as spin bulb film and tunnel junction film, single domain-ization of a freedom side ferromagnetism layer is wanted to realize. It is thought that single domain-ization of such freedom side ferromagnetism layers greatly contributes to reduction of a Barkhausen noise. The spin bulb film and the tunnel junction film are put between one pair of magnetic-domain control hard film in implementation of single-domain-izing. Such magneto-resistive effect film and the magnetic-domain control hard film are formed on a flattening side. for example, CPP structure — electromagnetism — such flattening sides are prescribed by the front face of a bottom drawer conductive layer by the sensing element.
[0003]
[Problem(s) to be Solved by the Invention] When the magneto-resistive effect film and the magnetic-domain control hard film are formed on a bottom drawer conductive layer as mentioned above, the magneto-resistive effect film contacts a bottom drawer conductive layer on the whole base. That is, according to the magnitude of the magneto-resistive effect film, a path will be inevitably determined as a sense current. In narrowing a path as a sense current, the magneto-resistive effect film must be reduced further. if a path can be narrowed as a sense current — read-out of magnetic information — hitting — electromagnetism — the sensibility of a sensing element can be raised.
[0004] that by which this invention was made in view of the above-mentioned actual condition — it is — electromagnetism — without it depends on contraction-ization of the conversion film — electromagnetism — the CPP structure which can narrow a path further as the current supplied to the conversion film — electromagnetism — it aims at offering offering a sensing element.
[0005]
[Means for Solving the Problem] the electromagnetism which lies in the summit side of an electric-conduction terminal strip at least with a bottom drawer conductive layer, the electric-conduction terminal strip which starts from the front face of a bottom drawer conductive layer, and the insulator layer which spreads on the front face of a bottom drawer conductive layer, touching the wall surface of an electric-conduction terminal strip according to this invention in order to attain the above-mentioned purpose — the conversion film and electromagnetism — the CPP structure characterized by to have a top drawer conductive layer in contact with the summit side of the conversion film — electromagnetism — a sensing element is offered.
[0006] such CPP structures — electromagnetism — a sensing element — an electric conduction terminal strip and electromagnetism — a path can be prescribed by the contact surface with the conversion film as a current. the passage of a current — a path — electromagnetism — it can be determined based on the breadth of the summit side of the electric conduction terminal strip in contact with the conversion film. namely, such CPP structures — electromagnetism — a sensing element — electromagnetism — the ** independent of contraction-ization of the conversion film — electromagnetism — a path can be narrowed as the current over the conversion film.
[0007] such CPP structures — electromagnetism — the case where a path is narrowed by the sensing element as a current — electromagnetism — the conversion film should just be prescribed by the 2nd piece with a bigger electric conduction terminal strip than the 1st piece. in this way — if the 1st piece of an electric conduction terminal strip is narrowed — electromagnetism — irrespective of the magnitude of the 2nd piece of the conversion film — electromagnetism — between the conversion film and an electric conduction terminal strip, a path is establishable as the current according to the magnitude of the 1st piece. According to the 1st-piece contraction, a path can be certainly narrowed as a current.
[0008] such CPP structures — electromagnetism — a sensing element — electromagnetism — 1 flattening side top may be specified between the conversion film, and the summit side of an electric conduction terminal strip and the front face of an insulator layer. such flattening side top — electromagnetism — if the conversion film is formed — electromagnetism — the dimensional accuracy and configuration precision of the conversion film can be raised. electromagnetism — the spin bulb film is sufficient as the conversion film, and the tunnel junction film is sufficient as it. electromagnetism — other magneto-resistive effect film may be used for the conversion film.

[0009] The above-mentioned bottom drawer conductive layer may consist of the magnetic substance. in this way -- if a bottom drawer conductive layer shows not only conductivity but magnetism -- a bottom drawer conductive layer -- electromagnetism -- it can function as a magnetic shielding layer of the conversion film. Therefore, it can greatly contribute to the so-called shortening of a reading gap. According to such shortenings which it reads and are gaps, the resolution of magnetic recording can be raised in the direction of a line of a recording track.
[0010] the above-mentioned top drawer conductive layer -- electromagnetism -- the 3rd piece with the conversion film smaller than the 2nd piece -- electromagnetism -- the terminal phyma in contact with the conversion film may be formed in one. in this way, a top drawer conductive layer and electromagnetism -- if the breadth of the contact surface is narrowed between conversion film -- electromagnetism -- irrespective of the magnitude of the 2nd piece of the conversion film -- electromagnetism -- between the conversion film and a top drawer conductive layer, a path is establishable as the current according to the magnitude of the 3rd piece. According to the 3rd-piece contraction, a path can be certainly narrowed as a current.
[0011] the above CPP structures -- electromagnetism -- the process at which the manufacture approach of a sensing element forms an electric-conduction wafer in the front face of for example, a drawer conductive layer, the process at which flattening processing is performed for an electric-conduction wafer to a wrap process and an insulator layer by the insulator layer by forming an insulator layer in the front face of a drawer conductive layer, and the summit side of an electric-conduction wafer exposes in respect of flattening on an insulator layer, and the electromagnetism which lie in the summit side of an electric-conduction wafer at least -- what is necessary is just to have the process which forms the conversion film on a flattening side especially -- such manufacture approaches -- a flattening side top -- electromagnetism -- electromagnetism since the conversion film is formed -- the dimensional accuracy and configuration precision of the conversion film can be raised. Here, an electric conduction wafer corresponds to the above-mentioned electric conduction terminal strip.
[0012] furthermore, CPP structure -- electromagnetism -- the manufacture approach of a sensing element may be equipped with the process which forms said drawer conductive layer according to a regular configuration pattern on the front face of a basic layer, and the process at which a basic insulator layer is formed in the front face of a basic layer, and it pulls out by the basic insulator layer, and flattening processing is performed to a wrap process and a basic insulator layer, a conductive layer pulls out in respect of flattening on a basic insulator layer, and the front face of a conductive layer exposes in advance of formation of an electric-conduction wafer. Especially, by such manufacture approaches, since an electric conduction wafer is formed on a flattening side, an electric conduction wafer can be formed in a certainly high precision.
[0013] furthermore, CPP structure -- electromagnetism -- the manufacture approach of a sensing element -- electromagnetism -- the process which forms a wrap covering insulator layer for the conversion film, and a covering insulator layer -- penetrating -- electromagnetism -- you may have the process which forms the contact hole which arrives at the front face of the conversion film, and the process which fills up the formed contact hole with an electrical conducting material. According to such a series of processes, the above-mentioned terminal phyma can be easily formed in a top drawer conductive layer in comparison.
[0014]
[Embodiment of the Invention] Hereafter, 1 operation gestalt of this invention is explained, referring to an accompanying drawing.
[0015] Drawing 1 shows roughly one example of a magnetic-recording medium driving gear, i.e., the internal structure of hard disk drive (HDD) 11. This HDD11 is equipped with the body 12 of a case of the cube type which divides the building envelope of a flat rectangular parallelepiped. The magnetic disk 13 of one or more sheets as a record medium is held in hold space. The revolving shaft of a spindle motor 14 is equipped with a magnetic disk 13. A spindle motor 14 can rotate a magnetic disk 13 at high speed, such as for example, 7200rpm and 10000rpm. It is combined with the body 12 of a case, the lid (not shown), i.e., covering, which seals hold space between the bodies 12 of a case.
[0016] The carriage 16 rocked by the circumference of the pivot 15 prolonged perpendicularly is further held in hold space. This carriage 16 is equipped with the swinging arm 17 of the rigid body horizontally prolonged from a pivot 15, and the elastic suspension 18 which is attached at the tip of this swinging arm 17, and extends ahead from a swinging arm 17. As everyone knows, at the tip of the elastic suspension 18, the cantilevered suspension of the surfacing head slider 19 is carried out by work of the so-called gimbal spring (not shown). Pressure acts on the surfacing head slider 19 from the elastic suspension 18 toward the front face of a magnetic disk 13. Buoyancy acts on the surfacing head slider 19 by work of the air current generated on the front face of a magnetic disk 13 based on rotation of a magnetic disk 13. The surfacing head slider 19 can continue surfacing with rigidity high in comparison during rotation of a magnetic disk 13 in the balance of the pressure of the elastic suspension 18, and buoyancy.
[0017] If carriage 16 rocks by the circumference of a pivot 15 during surfacing of such a surfacing head slider 19, the surfacing head slider 19 can cross the front face of a magnetic disk 13 to radial. Based on such migration, the surfacing head slider 19 is positioned in the recording track of the request on a magnetic disk 13. At this time, rocking of carriage 16 should just be realized through work of an actuator 21 called a voice coil motor (VCM). As everyone knows, when the magnetic disk 13 of two or more sheets is incorporated in the body 12 of a case, two elastic suspensions 18 are carried to one swinging arm 17 between magnetic-disk 13 adjoining comrades.
[0018] Drawing 2 shows one example of the surfacing head slider 19. This surfacing head slider 19 is aluminum 2O3 which is joined to the air outflow edge of the body 22 of a slider made from aluminum2 O3-TiC (Al Chick) formed in

a flat rectangular parallelepiped, and this body 22 of a slider, and builds in the read-out write-in head 23. It has the film 24 with a built-in head component of make (alumina). It is specified on the body 22 of a slider, and the film 24 with a built-in head component, the medium opposed face 25, i.e., the surfacing side, which counters a magnetic disk 13. The air current 26 generated based on rotation of a magnetic disk 13 is responded to by the surfacing side 25.
[0019] The rail 27 of two muscles prolonged toward an air outflow edge from an airstream ON edge is formed in the surfacing side 25. So-called ABS (air bearing surface)28 is specified in the summit side of each rail 27. In ABS28, the above-mentioned buoyancy is generated according to work of an air current 26. It was embedded on the film 24 with a built-in head component, and reads, and the write-in head 23 exposes the front end by ABS28 so that it may be mentioned later. In addition, the gestalt of the surfacing head slider 19 is not restricted to such gestalten.
[0020] Drawing 3 shows the situation of the surfacing side 25 to a detail. the read-out write-in head 23 — the thin film magnetic head 31, i.e., an induction write-in head component, and CPP structure — electromagnetism — it has a sensing element 32, i.e., a CPP structure magneto-resistive effect (MR) reading component. The induction write-in head component 31 can write binary information in a magnetic disk 13 as everyone knows using the field which occurs for example, by the electric conduction coil pattern (not shown). The CPP structure MR reading component 32 can detect binary information based on the resistance which changes as everyone knows according to the field which acts from a magnetic disk 13. The induction write-in head component 31 and the CPP structure MR reading component 32 are aluminum 2O3 which constitutes, the aluminum2 O3 film (alumina) 33 which constitutes, the above-mentioned top half layer of the film 24 with a built-in head component, i.e., overcoat film, and a bottom half layer, i.e., the under coat film. It is put between film (alumina) 34.
[0021] The induction write-in head component 31 is equipped with the up magnetic pole layer 35 in which the front end is exposed by ABS28, and the lower magnetic pole layer 36 in which the front end is similarly exposed by ABS28. The upper part and the lower magnetic pole layers 35 and 36 should just be formed from FeN or NiFe. The upper part and the lower magnetic pole layers 35 and 36 collaborate, and constitute the magnetic core of the induction write-in head component 31.
[0022] Between the upper part and the lower magnetic pole layers 35 and 36, it is aluminum 2O3. The nonmagnetic gap layer 37 of make (alumina) is put. As everyone knows, if a field occurs by the electric conduction coil pattern, by work of the nonmagnetic gap layer 37, the magnetic flux which goes back and forth the up magnetic pole layer 35 and the lower magnetic pole layer 36 will leak from the surfacing side 25, and it will come out of it. In this way, it leaks and the magnetic flux which comes out forms a record field (gap field).
[0023] The CPP structure MR reading component 32 is equipped with the bottom drawer conductive layer 38 which spreads along the front face of the alumina film 34, i.e., a substrate insulating layer. The bottom drawer conductive layer 38 is not only equipped with conductivity, but may equip coincidence with soft magnetism. If the bottom drawer conductive layer 38 consists of conductive soft magnetic materials called NiFe, this bottom drawer conductive layer 38 can function on coincidence as a lower shielding layer of the CPP structure MR reading component 32.
[0024] The electric conduction terminal strip 39 is arranged in the front face of the bottom drawer conductive layer 38. This electric conduction terminal strip 39 starts from the front face of the bottom drawer conductive layer 38. Wall surface 39a which starts from the front face of the bottom drawer conductive layer 38 is specified in the electric conduction terminal strip 39. The electric conduction terminal strip 39 is not only equipped with conductivity, but may equip coincidence with soft magnetism similarly. If the electric conduction terminal strip 39 consists of conductive soft magnetic materials called NiFe, this electric conduction terminal strip 39 can function on coincidence as a lower shielding layer of the CPP structure MR reading component 32.
[0025] The bottom drawer conductive layer 38 is embedded at the insulating layer 41 which spreads on the front face of the alumina film 34. This insulating layer 41 spreads along the front face of the bottom drawer conductive layer 38, touching wall surface 39a of the electric conduction terminal strip 39. Here, the summit side of the electric conduction terminal strip 39 and the front face of an insulating layer 41 specify 1 flattening side 42 which continues without a break.
[0026] the electromagnetism prolonged along with ABS28 on the flattening side 42 — the conversion film 43, i.e., the magneto-resistive effect (MR) film, is formed. This MR film 43 lies in the summit side of the electric conduction terminal strip 39 at least. In this way, electrical installation is established only by leading the electric conduction terminal strip 39 between the MR film 43 and the bottom drawer conductive layer 38. The detail of the structure of the MR film 43 is mentioned later.
[0027] Similarly, on the flattening side 42, one pair of magnetic-domain control hard film 44 prolonged along with ABS28 is formed. The magnetic-domain control hard film 44 puts the MR film 43 along with ABS28 on the flattening side 42. The magnetic-domain control hard film 44 should just be formed from metallic materials, such as CoPt and CoCrPt. By these magnetic-domain control hard film 44, magnetization is establishable as everyone knows along one direction which crosses the MR film 43. If a bias field is formed based on magnetization of such magnetic-domain control hard film 44, single domain-ization of for example, a freedom side ferromagnetism layer (free layer) is realizable within the MR film 43.
[0028] On the flattening side 42, the covering insulator layer 45 covers and hangs further. This covering insulator layer 45 puts the MR film 43 and the magnetic-domain control hard film 44 between insulating layers 41. The top drawer conductive layer 46 spreads in the front face of the covering insulating layer 45. The top drawer conductive layer 46 is not only equipped with conductivity, but may equip coincidence with soft magnetism like the above-mentioned bottom drawer conductive layer 38. If the top drawer conductive layer 46 consists of conductive soft

magnetic materials called NiFe, this top drawer conductive layer 46 can function on coincidence as an up shielding layer of the CPP structure MR reading component 32. Spacing with the above-mentioned lower shielding layer 38, i.e., a bottom drawer conductive layer, and the top drawer conductive layer 46 determines the resolution of magnetic recording in the direction of a line of a recording track on the record disk 13. The terminal phyma 47 which penetrates the covering insulator layer 45 in the top drawer conductive layer 46, and contacts the summit side of the MR film 43 is formed in one. In this way, between the MR film 43 and the top drawer conductive layer 46, electrical installation is established only through the terminal phyma 47.

[0029] The bottom drawer conductive layer 38 spreads back along the front face of the alumina film 34 from the front end exposed by ABS28 so that clearly from drawing 4 . A terminal pad 48 is connected with the back end of the bottom drawer conductive layer 38. A terminal pad 48 should just spread along the front face of the bottom drawer conductive layer 38. A terminal pad 48 is connected to the terminal pad by the side of the elastic suspension 18 (not shown) through Au ball (not shown) etc., in case the surfacing head slider 19 is fixed to the elastic suspension 18.

[0030] The top drawer conductive layer 46 spreads back along the front face of the covering insulator layer 45 from the front end exposed by ABS28 so that clearly from drawing 5 . A terminal pad 49 is connected with the back end of the top drawer conductive layer 46. A terminal pad 49 should just spread along the front face of the top drawer conductive layer 46. Like the above-mentioned, a terminal pad 49 is connected to the terminal pad by the side of the elastic suspension 18 (not shown) through Au ball (not shown) etc., in case the surfacing head slider 19 is fixed to the elastic suspension 18.

[0031] As shown in drawing 6 , the width of face W1 of the electric conduction terminal strip 39 is set up remarkably small rather than the width of face W2 of the MR film 43. Width-of-face W3 of the terminal phyma 47 is set as coincidence remarkably small rather than the width of face W2 of the MR film 43. Each width of face W1 and W2 and W3 should just be measured along with ABS28 in parallel with the flattening side 42. The width of face W2 of the MR film 43 determines the resolution of magnetic recording as radial [of a magnetic disk 13]. The width of face W1 of the electric conduction terminal strip 39 and width-of-face W3 of the terminal phyma 47 may be set up equally.

[0032] With the above CPP structure MR reading components 32, a sense current is supplied to the MR film 43 from a top and the bottom drawer conductive layers 46 and 38. At this time, by the MR film 43, a path can be narrowed by work of the electric conduction terminal strip 39 and the terminal phyma 47 as a sense current so that clearly from drawing 6 . And by such MR film 43, it keeps away from the contact surface with the magnetic-domain control hard film 44, and a path can be established near the center of the MR film 43 as a current.

[0033] Drawing 7 shows one example of the MR film 43. This MR film 43 consists of so-called spin bulb film. That is, by the MR film 43, the substrate layer 51, the freedom side ferromagnetism layer 52, the nonmagnetic interlayer 53, the fixed side ferromagnetism layer (pinned layer) 54, the antiferromagnetism layer (pinning layer) 55, and a protective layer 56 pile up in order. According to work of the antiferromagnetism layer 55, magnetization of the fixed side ferromagnetism layer 54 is fixed in the one direction. Here, the substrate layer 51 should just consist of Ta layer 51a and NiFe layer 51b by which a laminating is carried out to the front face of this Ta layer 51a. The freedom side ferromagnetism layer 52 and the fixed side ferromagnetism layer 54 should just be formed from a ferromagnetic ingredient called Co90Fe10. The nonmagnetic interlayer 53 should just be formed from an electric conduction metallic material called Cu. The antiferromagnetism layer 55 should just be formed from antiferromagnetism alloy ingredients, such as FeMn and PdPtMn. A protective layer 56 should just be equipped with Cu layer 56a and cap layer, i.e., Ta layer, 56b formed on this Cu layer 56a.

[0034] If the CPP structure MR reading component 32 is opposed to the front face of a magnetic disk 13 in read-out of magnetic information, by the spin bulb film, the magnetization direction of the freedom side ferromagnetism layer 52 will be rotated as everyone knows according to the sense of the field which acts from a magnetic disk 13. In this way, rotation of the magnetization direction of the freedom side ferromagnetism layer 52 changes the electric resistance of the spin bulb film a lot. Therefore, if a sense current is supplied to the spin bulb film from a top and the bottom drawer conductive layers 46 and 38, the level of the electrical signal taken out from terminal pads 48 and 49 will change according to change of electric resistance. Binary information can be read according to change of this level. At this time, a path can be narrowed as mentioned above by the spin bulb film as a sense current. Consequently, the response sensibility of the spin bulb film to the field which acts from a magnetic disk 13 can be raised.

[0035] Next, the manufacture approach of the surfacing head slider 19 is explained briefly. First, as shown in drawing 8 , the wafer 61 made from aluminum2 O3-TiC (Al Chick) is prepared. In the front face of a wafer 61, it is aluminum 2O3. The laminating of the film (alumina) 34 is carried out. The flat side 62 is formed in the periphery of a wafer 61. The sense of a wafer 61 can be specified based on this flat side 62.

[0036] As everyone knows, in the front face of a wafer 61, many read-out write-in heads 23 are built. The read-out write-in head 23 is formed every block 63 started by 1 surfacing head slider 19, as shown in drawing 9 . For example, in the wafer 61 with a diameter of 5 inches, a total of 10000 surfacing head sliders 19 can be started in 100-line 100 trains. The detail of the formation approach of the read-out write-in head 23 is mentioned later. It was formed, and reads and the write-in head 23 is covered with the alumina film 33. In this way, on a wafer 61, it was embedded on the film 24 with a built-in head component made from an alumina, and reads, and the write-in head 23 is obtained.

[0037] In this way, if it reads and the write-in head 23 is built, as shown in drawing 10 , the wafer bar 64 with which the above-mentioned block 63 was located in a line with the single tier will be cut down from a wafer 61. The wafer

bar 64 is cut down by slitting parallel to the above-mentioned flat side 62. Cutting plane 64a parallel to the flat side 62 is specified to the cut-down wafer bar 64. As everyone knows, the surfacing side 25 of the surfacing head slider 19 is formed by cutting plane 64a every block 63. Then, the surfacing head slider 19 is started every block 63 from the wafer bar 64.

[0038] Here, the formation approach of the read-out write-in head 23 is explained in full detail. As shown in drawing 11 , on a wafer 61, the laminating of the conductive magnetic film 65 is carried out to the front face of the basic layer 34, i.e., the alumina film. For example, the sputtering method should just be used for a laminating. A magnetic film 65 should just consist of soft magnetic materials called NiFe. Such magnetic films 65 are uniformly formed in the front face of a wafer 61.

[0039] Then, on a wafer 61, the bottom drawer conductive layer 38 is formed every above-mentioned block 63. On the front face of the alumina film 34, the bottom drawer conductive layer 38 begins to be deleted from a magnetic film 65 according to a regular configuration pattern. A configuration pattern should just be prescribed by the photoresist film 66 as shown in drawing 12 . If etching processing is performed to a magnetic film 65 around the photoresist film 66, the magnetic film 65 modeled after the configuration pattern under the photoresist film 66 remains. In this way, the bottom drawer conductive layer 38 can be formed. The photoresist film 66 is removed after etching processing.

[0040] As shown in drawing 13 , the basic insulator layer 67 is formed in the front face of the alumina film 34. This basic insulator layer 67 is aluminum 2O3. SiO2 What is necessary is to just be formed from the said insulating material. The basic insulator layer 67 is uniformly formed in the front face of a wafer 61. Consequently, the bottom drawer conductive layer 38 on the alumina film 34 is covered with the basic insulator layer 67.

[0041] Then, flattening processing is performed to the basic insulator layer 67. flattening processing -- for example, CMP (chemical mechanical polishing) -- law should just be used. In addition, it may replace with the CMP method, argon cluster processing may be used, and, in addition to the CMP method, argon cluster processing may be performed. Flattening processing is continued until the bottom drawer conductive layer 38 is exposed, as shown in drawing 14 . The front face of the bottom drawer conductive layer 38 and the front face of the basic insulator layer 67 constitute 1 flattening side 68.

[0042] In this way, the electric conduction terminal strip 39 is formed on the formed flattening side 68. For example, as shown in drawing 15 , on a wafer 61, the laminating of the magnetic film 69 is again carried out in formation. For example, the sputtering method should just be used for a laminating. A magnetic film 69 should just consist of soft magnetic materials called NiFe. Such magnetic films 69 are uniformly formed in the front face of a wafer 61.

[0043] Then, on a wafer 61, the electric conduction wafer 71 is formed every block 63. On the front face of the bottom drawer conductive layer 38, the electric conduction wafer 71 begins to be deleted from a magnetic film 69 according to a regular configuration pattern. A configuration pattern should just be prescribed by the photoresist film 72 as shown in drawing 16 . If etching processing is performed to a magnetic film 69 around the photoresist film 72, the magnetic film 69 modeled after the configuration pattern under the photoresist film 72 remains. In this way, the electric conduction wafer 71 can be formed. The photoresist film 72 is removed after etching processing.

[0044] As shown in drawing 17 , the middle insulator layer 73 is formed in the front face of the bottom drawer conductive layer 38, and the front face of the basic insulator layer 67 on a wafer 61. This middle insulator layer 73 is aluminum 2O3. SiO2 What is necessary is to just be formed from the said insulating material. The middle insulator layer 73 is uniformly formed in the front face of a wafer 61. Consequently, the electric conduction wafer 71 on the bottom drawer conductive layer 38 is covered with the middle insulator layer 73.

[0045] Then, flattening processing is performed to the middle insulator layer 73. flattening processing -- for example, CMP (chemical mechanical polishing) -- law should just be used. In addition, it may replace with the CMP method, argon cluster processing may be used, and, in addition to the CMP method, argon cluster processing may be performed. Flattening processing is continued until the electric conduction wafer 71 is exposed, as shown in drawing 18 . The summit side of the electric conduction wafer 71 and the front face of the middle insulator layer 73 constitute 1 flattening side 74. In this way, the electric conduction terminal strip 39 is formed.

[0046] In this way, the MR film 43 and the magnetic-domain control hard film 44 are formed every block 63 on the formed flattening side 74. First, on a wafer 61, as shown, for example in drawing 19 , the layered product 75 equipped with the same layer structure as the above-mentioned MR film 43 is formed. For example, the sputtering method should just be used for formation. A layered product 75 should just be uniformly formed in the front face of a wafer 61. On the flattening side 74, each class of a layered product 75 can be accumulated in a high precision.

[0047] Then, on the wafer 61, the magnetic-domain control hard film 44 is formed. For example, the space 76 which modeled one pair of magnetic-domain control hard film 44 after the layered product 75 every block 63 as shown in drawing 20 is *************. In this ********, as shown in drawing 21 , the photoresist film 77 which modeled the profile of space 76 is formed in the front face of a layered product 75. If a layered product 75 is put to etching processing after formation of the photoresist film 77, space 76 will be formed into a layered product 75. The front face of the middle insulator layer 73 is exposed in space 76.

[0048] As shown in drawing 22 , subsequently on a wafer 61, the laminating of the magnetic film 78 is carried out. Space 76 is filled up with a magnetic film 78. The magnetic-domain control hard film 44 is established in space 76. If the photoresist film 77 is removed after formation of this magnetic film 78, the magnetic film 78 on a layered product 75 can be removed from a wafer 61. The front face of a layered product 75 is exposed again.

[0049] In this way, formation of the magnetic-domain control hard film 44 forms the MR film 43 every block 63. The MR film 43 should just begin to be deleted from a layered product 75 for example, based on the etching method. In

beginning to delete, as shown in drawing 23 , on this layered product 75 that remains, and the magnetic-domain control hard film 44, the photoresist film 79 of one muscle prolonged in the one direction is formed. If a layered product 75 and the magnetic-domain control hard film 44 fail to be shaved around the photoresist film 79, the continuum of the MR film 43 prolonged in the one direction on the flattening side 74 and the magnetic-domain control hard film 44 can be formed. At this time, the MR film 43 which began to be shaved lies in the summit side of the electric conduction terminal strip 39 at least. Thus, since the MR film 43 and the magnetic-domain control hard film 44 are formed on the flattening side 74, by the MR film 43 or the magnetic-domain control hard film 44, close dimensional accuracy (configuration precision) is realizable. In this way, after the continuum of the MR film 43 and the magnetic-domain control hard film 44 is formed, the photoresist film 79 is removed.
[0050] Then, as shown in drawing 24 , the covering insulator layer 81 is formed on the flattening side 74 exposed again. This covering insulator layer 81 is aluminum 2O3. SiO2 What is necessary is to just be formed from the said insulating material. The covering insulator layer 81 is uniformly formed in the front face of a wafer 61. Consequently, on the flattening side 74, the continuum of the MR film 43 and the magnetic-domain control hard film 44 is covered with the covering insulator layer 81.
[0051] In this way, as shown in drawing 25 , the contact hole 82 which arrives at the front face of the MR film 43 every block 63 is formed in the formed covering insulator layer 81. The photoresist film 83 which modeled the profile of the contact hole 82 is formed in the front face of the covering insulator layer 81 in formation of the contact hole 82. If etching processing is performed, the contact hole 82 which penetrates the covering insulator layer 81 will be formed in the covering insulator layer 81. The contact hole 82 exposes the summit side of the MR film 43. Formation of the contact hole 82 removes the photoresist film 83.
[0052] The top drawer conductive layer 46 is formed in the front face of the covering insulator layer 81 after formation of such a contact hole 82. As it is in charge of formation of the besides side drawer conductive layer 46, for example, is shown in drawing 26 , the laminating of the conductive magnetic film 84 is carried out to the front face of a wafer 61. For example, the sputtering method should just be used for a laminating. A magnetic film 84 should just consist of soft magnetic materials called NiFe. Such magnetic films 84 are uniformly formed in the front face of a wafer 61. Therefore, the contact hole 82 is filled up with the conductive magnetic film 84.
[0053] On a wafer 61, the top drawer conductive layer 46 is formed every block 63. On the front face of the covering insulator layer 81, the top drawer conductive layer 46 begins to be deleted from a magnetic film 84 according to a regular configuration pattern. A configuration pattern should just be prescribed by for example, the photoresist film (not shown). If etching processing is performed to a magnetic film 84 around the photoresist film, the magnetic film 84 modeled after the configuration pattern under the photoresist film remains. In this way, the top drawer conductive layer 46 can be formed. The photoresist film is removed after etching processing.
[0054] In this way, on the built CPP structure MR reading component 32, the induction write-in head component 31 is built as known. In advance of this construction, the CPP structure MR reading component 32 may be embedded at a nonmagnetic insulator layer (not shown). On the front face of this nonmagnetic insulator layer, the insulating layer and the up magnetic pole layer 35 where the coil pattern besides the lower magnetic pole layer 36 or the nonmagnetic gap layer 37 was embedded are formed successively. In advance of formation of such induction write-in head components 31, flattening processing may be performed to the front face of a nonmagnetic insulator layer. If the induction write-in head component 31 is finally embedded on the alumina film 33, formation of the read-out write-in head 23 will be completed.
[0055] Drawing 27 shows other examples of the MR film 43. This MR film 43 consists of tunnel junction film. That is, by the MR film 43, the substrate layer 101, the freedom side ferromagnetism layer 102, an insulator layer 103, the fixed side ferromagnetism layer 104, the antiferromagnetism layer 105, and a protective layer 106 pile up in order. According to work of the antiferromagnetism layer 105, magnetization of the fixed side ferromagnetism layer 104 is fixed in the one direction. Here, the substrate layer 101 should just consist of Ta layer 101a and NiFe layer 101b by which a laminating is carried out to the front face of this Ta layer 101a. The freedom side ferromagnetism layer 102 and the fixed side ferromagnetism layer 104 should just be formed from a ferromagnetic ingredient called Co90Fe10. An insulator layer 103 should just be formed from the metal oxide film of for example, aluminum2 O3 and others (alumina). The antiferromagnetism layer 105 should just be formed from antiferromagnetism alloy ingredients, such as FeMn and PdPtMn. A protective layer 106 should just be equipped with Cu layer 106a and cap layer, i.e., Ta layer, 106b formed on this Cu layer 106a.
[0056] If the CPP structure MR reading component 32 is opposed to the front face of a magnetic disk 13 in read-out of magnetic information, by the tunnel junction film, the magnetization direction of the freedom side ferromagnetism layer 102 will be rotated as everyone knows according to the sense of the field which acts from a magnetic disk 13. In this way, rotation of the magnetization direction of the freedom side ferromagnetism layer 102 changes the electric resistance of the tunnel junction film a lot. Therefore, if a sense current is supplied to the tunnel junction film from a top and the bottom drawer conductive layers 46 and 38, the level of the electrical signal taken out from terminal pads 48 and 49 will change according to change of electric resistance. Binary information can be read according to change of this level. At this time, a path can be narrowed as mentioned above by the tunnel junction film as a sense current. Consequently, the response sensibility of the tunnel junction film to the field which acts from a magnetic disk 13 can be raised.
[0057]
[Effect of the Invention] according to this invention as mentioned above — electromagnetism — without it depends on contraction-ization of the conversion film — electromagnetism — the CPP structure which can narrow a path

further as the current supplied to the conversion film -- electromagnetism -- a sensing element is offered.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view showing the internal structure of hard disk drive (HDD) roughly.
[Drawing 2] It is the expansion perspective view showing one example of a surfacing head slider.
[Drawing 3] It is the front view showing roughly the situation of the read-out write-in head observed in respect of surfacing.
[Drawing 4] It is the top view showing the bottom drawer conductive layer of a CPP structure magneto-resistive effect (MR) reading component.
[Drawing 5] It is the top view showing the top drawer conductive layer of a CPP structure MR reading component.
[Drawing 6] It is the expansion partial front view of a CPP structure MR reading component showing a path roughly as a sense current.
[Drawing 7] It is the expansion front view showing roughly the structure of the spin bulb film concerning one example of MR film.
[Drawing 8] It is the perspective view of a wafer.
[Drawing 9] It is the expansion part plan of the wafer in which two or more read-out write-in heads formed on the wafer are shown.
[Drawing 10] It is the perspective view showing the wafer bar cut down from the wafer.
[Drawing 11] It is the expansion fragmentary sectional view of the wafer in which the process which forms a bottom drawer conductive layer on the front face of a basic layer is shown.
[Drawing 12] It is the expansion fragmentary sectional view of the wafer in which the process which forms a bottom drawer conductive layer on the front face of a basic layer is shown.
[Drawing 13] It is the expansion fragmentary sectional view of the wafer in which the process which forms a basic insulator layer in the front face of a basic layer is shown.
[Drawing 14] It is the expansion fragmentary sectional view of the wafer in which the process at which the front face of a bottom drawer conductive layer is exposed is shown.
[Drawing 15] It is the expansion fragmentary sectional view of the wafer in which the process which forms an electric conduction wafer on the front face of a bottom drawer conductive layer is shown.
[Drawing 16] It is the expansion fragmentary sectional view of the wafer in which the process which forms an electric conduction wafer on the front face of a bottom drawer conductive layer is shown.
[Drawing 17] It is the expansion fragmentary sectional view of the wafer in which the process which forms an insulator layer on a flattening side is shown.
[Drawing 18] It is the expansion fragmentary sectional view of the wafer in which the process at which the summit side of an electric conduction wafer is exposed is shown.
[Drawing 19] It is the expansion fragmentary sectional view of the wafer in which the process which forms a layered product equipped with the same layer structure as the spin bulb film is shown.
[Drawing 20] It is the expansion part plan of the wafer which shows **************** to a layered product.
[Drawing 21] It is the expansion fragmentary sectional view of the wafer in which a ******** process is shown for space by the layered product.
[Drawing 22] It is the expansion fragmentary sectional view of the wafer in which the process which fills up **************** with the magnetic substance is shown.
[Drawing 23] It is the expansion part plan of the wafer in which the resist film which specifies the continuum of MR film and the magnetic-domain control hard film is shown.
[Drawing 24] It is the expansion fragmentary sectional view of the wafer in which the process which forms the covering insulator layer which buries the continuum of MR film and the magnetic-domain control hard film is shown.
[Drawing 25] It is the expansion fragmentary sectional view of the wafer in which the process which forms a contact hole in a covering insulator layer is shown.
[Drawing 26] It is the expansion fragmentary sectional view of the wafer in which the process which forms a top drawer conductive layer is shown.
[Drawing 27] It is the expansion front view showing roughly the structure of the tunnel junction film concerning other examples of MR film.
[Description of Notations]
32 CPP Structure — Electromagnetism — CPP Structure Magneto-resistive Effect (MR) Reading Component as a Sensing Element — 34 aluminum 2O3 as a basic layer The film (alumina), 38 Bottom drawer conductive layer, 39

Electric conduction terminal strip, 39a The wall surface of an electric conduction terminal strip, 41 The insulating layer containing an insulator layer, 42 1 flattening side and 43 electromagnetism -- the magneto-resistive effect (MR) film as conversion film -- 45 A covering insulator layer, 46 A top drawer conductive layer, 47 Terminal phyma, 67 A basic insulator layer, 68 The flattening side on a basic insulator layer, 71 An electric conduction wafer, 74 The flattening side on an insulator layer, 81 A covering insulator layer, 82 A contact hole, 84 The magnetic film as an electrical conducting material, W1 The 1st piece, W2 The 2nd piece, the 3rd piece of W3.

[Translation done.]